DEVENS PFAS REMEDIAL INVESTIGATION

Area 1 Field Sampling Planning Meeting

24 May 2018

Groundwater

- Groundwater vertical profiling will be completed at Area 1 using direct push technology to define the vertical and lateral extent of PFAS contamination in groundwater at and near the Grove Pond municipal wellfield, and AOCs 57, 74, and 75 at Devens. The extent of vertical profiling activities within each area of investigation is provided on Figure 1 and is intended to assist reviewers in visualization of all the activities in Area 1.
- Proposed vertical profiling locations at each AOC and the Grove Pond municipal wellfield are shown on Figures 2 to 7.
    - The yellow "Groundwater Vertical Profiling Transects" shown on figures 2 to 6 are provided to aid reviewers in assessing relative positions of vertical profiling locations with respect to approximate groundwater flow direction and other vertical profiling locations.
    - The "Subsequent Groundwater Vertical Profiling Transects" shown on Figure 7 will be used to approximate areas for subsequent groundwater vertical profiling locations that will likely be needed to track PFAS impacts at the Grove Pond wellfield back to a potential source(s) at Devens.
- The rationale and sampling plan for each groundwater vertical profile location proposed for Area 1 is provided in Table 1.
- The groundwater vertical profiling samples will be collected at 10-foot intervals from the water table to refusal or bedrock. The samples will be analyzed for PFAS via Method 537.
- At AOCs 57, 74 and 75, the groundwater vertical profile borings are generally located within, downgradient, upgradient and cross gradient to areas of known PFAS groundwater contamination (Figure 2 to 6).
- The initial set of 8 groundwater vertical profile borings at the Grove Pond municipal wellfield are located on a perimeter around the wellfield to characterize PFAS in groundwater that may be entering the wellfield from all directions (Figure 7).
    - No step-outs are planned for off-base vertical profiles that have PFAS.
    - Additional transects of vertical profiling locations will likely be needed at Devens upgradient of the Grove Pond wellfield. Vertical profile locations may step out to define the width of the plume or perpendicular to groundwater flow to delineate plume length, delineate the core, and find a potential source(s). The general location of transects upgradient of the Grove Pond wellfield are shown on Figure 7. Subsequent vertical collection intervals may be revised based on initial results.

- The groundwater vertical profiling PFAS data set will be augmented with sampling for PFAS at existing monitoring wells, if present. The samples will be analyzed for PFAS via Method 537. The locations of existing groundwater monitoring wells are shown on Figures 4 through 7. Well construction information for existing monitoring wells to be sampled for PFAS at each area (if present) is provided in Table 2.
- Additional groundwater vertical profiling locations may be necessary. The PFAS results from the groundwater vertical profiles and existing monitoring wells will be reviewed to determine if data gaps regarding the extent of PFAS contamination in groundwater remain. The collection intervals for additional groundwater vertical profiling locations may be revised based on initial results.

Soil

- Soil borings will be advanced at AOCs 57, 74, and 75 using direct push technology to collect soil samples to determine the nature and extent of soil contamination, to assess the potential of an ongoing source, and to provide data for the completion of human health and ecological risk assessments. At AOC 74 seven soil borings, at AOC 75 six soil borings, at AOC 57 Area 1 two soil borings, at AOC 57 Area 2 six soil borings, and at AOC 57 Area 3 four soil borings are planned.
- The locations of soil borings are shown on Figures 2 through 6. In general, borings will be advanced within, upgradient, downgradient, and cross gradient of areas of PFAS soil and/or groundwater contamination identified in the SI (Weston, 2018) and the LTM groundwater sampling event (KGS, 2018). Some of the soil borings are collocated with vertical profiling locations.
- Vadose zone soil samples will be collected from the following depth intervals and submitted for PFAS analysis via Method 537:

  0 - 0.5 ft
  0.5 - 3 ft
  3 - 7 ft
  7 - 15 ft
  Within 2 feet of the water table

- The PFAS results from the 0 - 0.5 ft and the 0.5-3 ft samples will be used to support the ecological risk evaluation. The PFAS results from 0-15 ft intervals will be used to provide data to evaluate risks to human health through a residential exposure scenario to accessible soils (0-3 ft) and construction worker exposure scenario to potentially accessible soils (3-15 ft). Soil samples will be collected within two-feet of the water table (if the water table is deeper than the intervals specified above) and submitted for PFAS analysis to provide additional data for evaluating a potential leaching threat to groundwater.
- Final depth of soil sampling intervals will end at the water table at locations where water table is less than 15 feet.
- PFAS soil data will be reviewed to identify soil samples with highest PFAS concentrations. Soil samples with the highest reported PFAS concentrations will be submitted for total oxidizable precursor assay (TOPA) and total organic carbon (TOC) analysis.

- The need for soil sampling near the Grove Pond municipal wellfield is not anticipated at this time. PFAS groundwater contamination in this investigation area is likely distal from the source and likely exists only in dissolved phase.
- If a source soil area (other than AOCs 74, 75 or 57) is identified within Area 1, additional soil borings may be conducted.
- It is anticipated that the planned soils borings at each AOC will encompass the lateral extent of soil contamination. If not, additional soil borings may be necessary. The number and location of subsequent soil borings will be determined based on review of initial soil boring results, initial vertical profiling results, and results of samples collected from existing monitoring wells.

Surface Water and Sediment

- Surface water and sediment samples will be collected from six locations along Cold Spring Brook (Figure 8). The samples will be analyzed for PFAS via Method 537, TOC, and grain size.
    - This initial transect has been designed to assess if there is potential for an ecological or human health risk from exposure to PFAS that may be present in sediments and surface water at Cold Spring Brook.
    - If PFAS concentrations in surface water and/or sediment exceed the site-specific screening levels, additional samples may be needed to identify the AOC contributing the greatest risk. The additional sample locations will be based on initial PFAS results.
- Surface water and sediment samples will be collected from five locations within Grove Pond and from one location at Balch Pond. The samples will be analyzed for PFAS via Method 537, TOC, and grain size.

Installation of New Monitoring Wells

- Approximately 30 new monitoring wells are anticipated be installed at Area 1. At AOC 74 an estimated six wells, at AOC 75 an estimated six wells, at AOC 57 Area 1 an estimated five wells, at AOC 57 Area 2 an estimated five wells, and upgradient of the Grove Pond wellfield and estimated 8 wells would be installed.
- The locations and screen settings of the new groundwater monitoring wells will be based on a review of the PFAS data obtained from groundwater vertical profiling, soil sampling and existing monitoring wells.
- The monitoring well network will be designed to monitor areas of PFAS groundwater contamination delineated within Area 1 as well as provide bounding locations to demonstrate the limits of PFAS contamination in groundwater.
- Monitoring well couplets will be installed adjacent to Cold Spring Brook at AOCs 74 and 57 (areas 2 and 3) to evaluate the potential for vertical gradients on the northwestern side of Cold Spring brook.

- During well installation at select borings, soil core samples will be collected in the saturated zone for field lithologic classification. Select samples from the core will be submitted for TOC and grain size analysis.
- After new monitoring wells are installed, a synoptic water level measurement event will be conducted for Area 1 to evaluate groundwater flow within and between each area of investigation.
- Groundwater samples will be collected from the new monitoring wells and analyzed for PFAS via Method 537. Select wells screened within the plume(s) will be sampled for dissolved organic carbon and TOPA.

Table 1
Groundwater Vertical Profiling Rationale
Area 1 Field Sampling Plan
Devens PFAS RI Workplan

Proposed Location	Rationale	Path Forward If PFAS is Detected in Groundwater[(1)]
Grove Pond Municipal Well Field		
GPVP-1	Determine if PFAS is present in groundwater to the northwest of Grove Pond Wellfield.	• No additional profiling needed. • Inform stakeholders of PFAS contamination at this location.
GPVP-2	Determine if PFAS is present in groundwater to the north of Grove Pond Wellfield.	• No additional profiling needed. • Inform stakeholders of PFAS contamination at this location.
GPVP-3	Determine if PFAS is present in groundwater to the northeast of Grove Pond Wellfield.	• No additional profiling needed. • Inform stakeholders of PFAS contamination at this location.
GPVP-4	Determine if PFAS is present in groundwater to the east of Grove Pond Wellfield.	• No additional profiling needed. • Inform stakeholders of PFAS contamination at this location.
GPVP-5	Determine if PFAS is present in groundwater to the east of Grove Pond Wellfield.	• Evaluate flow direction for additional vertical profile borings located upgradient or cross gradient.
GPVP-6	Characterize vertical extent of PFAS contamination in an area of known groundwater contamination to the south of Grove Pond Wellfield.	• Establish a vertical profile location further upgradient, to the south of GPVP-6. Distance is anticipated to be along a transect that passes through MNG-2 through MNG-7.
GPVP-7	Characterize vertical extent of PFAS contamination in an area of known groundwater contamination to the south of Grove Pond Wellfield.	• Establish a vertical profile location further upgradient, to the south of GPVP-7. Distance is anticipated to be along a transect that passes through MNG-2 through MNG-7.
GPVP-8	Determine if PFAS is present in groundwater to the west of Grove Pond Wellfield.	• Establish a vertical profile location further upgradient, to the south and west of GPVP-8. Distance is anticipated to be along a transect that passes through MNG-2 through MNG-7.
Area of Concern 74		
74VP-1	Characterize vertical extent of PFAS contamination in groundwater in area of known PFAS contamination.	• Evaluate data from surrounding locations.
74VP-2	Characterize vertical extent of PFAS contamination in groundwater in aquifer downgradient of known PFAS contamination and adjacent to Cold Spring Brook.	• Evaluate data from surrounding locations. • Evaluate potential for underflow of Cold Spring Brook, by reviewing elevation of observed PFAS in groundwater and measuring vertical hydraulic gradients with installation of nested piezometers or monitoring wells at this location.
74VP-3	Bound extent of PFAS contamination in groundwater to the southwest.	• Evaluate need for a vertical profile location cross gradient further to the southwest based on a review of magnitude and depth of detections at this profile.
74VP-4	Bound extent of PFAS contamination in groundwater to the northeast.	• Evaluate need for a vertical profile location cross gradient further to the northeast based on a review of magnitude and depth of detections at this profile.
74VP-5	Determine if PFAS contamination is present in groundwater to the east of Bldg. 3773 at AOC 74.	• Evaluate need for a vertical profile location cross gradient further to the northeast based on a review of magnitude and depth of detections at this profile.

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74VP-6	Determine if PFAS contamination is present in groundwater to the north of Bldg. 3773 at AOC 74.	• Evaluate need for a vertical profile locations to the southwest based on a review of magnitude and depth of detections at this profile.
74VP-7	Determine if PFAS contamination is present in groundwater to the north of Bldg. 3773 at AOC 74.	• Evaluate need for a vertical profile locations to the north based on a review of magnitude and depth of detections at this profile.
74VP-8	Determine if PFAS contamination is present in groundwater to the north of Bldg. 3773 at AOC 74.	• Evaluate vertical profile data in conjunction with vertical profile results obtained from Grove Pond investigation area.
Area of Concern 75		
75VP-1	Determine if PFAS is present in groundwater upgradient of AOC-75.	• Evaluate need for a vertical profile that is further upgradient of location 75VP-1 based on a review of the magnitude and depth of detections at this profile.
75VP-2	Determine if PFAS is present in groundwater downgradient, to the northeast of known PFAS detections in groundwater at AOC-75.	• Evaluate need for a vertical profile location that is further cross gradient, to the north of 75VP-2 based on a review of the magnitude and depth of detections at this profile. • Evaluate need for a vertical profile location further downgradient, to the east of 75VP-2 based on a review of the magnitude and depth of detections at this profile.
75VP-3	Determine if PFAS is present in groundwater that is downgradient of known PFAS detections in AOC-75 groundwater.	• Evaluate need for a profile location that is further downgradient, to the east, of 75VP-3 based on a review of the magnitude and depth of detections at AOC-75 and AOC 57 Area 1 (located to the east and downgradient).
75VP-4	Determine if PFAS is present in groundwater downgradient, to the southeast of known PFAS detections at AOC-75.	• Evaluate need for a vertical profile location that is further cross gradient, to the south of 75VP-4 based on a review of the magnitude and depth of detections at this profile. • Evaluate need for a vertical profile location further downgradient, to the east of 75VP-4 based on a review of the magnitude and depth of detections at this profile.
75VP-5	Determine if PFAS is present in groundwater cross gradient, to the north of known PFAS detections at AOC-75.	• Evaluate need for a vertical profile location that is further cross gradient, to the north of 75VP-5 based on a review of the magnitude and depth of detections at this profile.
75VP-6	Characterize vertical extent of PFAS in an area of known groundwater contamination at AOC 75.	• Evaluate data from surrounding locations.
75VP-7	Determine if PFAS is present in groundwater cross gradient, to the south of known PFAS detections at AOC-75.	• Evaluate need for a vertical profile location that is further cross gradient, to the south of 75VP-7 based on a review of the magnitude and depth of detections at this profile.

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Proposed Location	Rationale	Path Forward If PFAS is Detected in Groundwater[(1)]
Area of Concern 57, Area 1		
57VP-1-1	Determine if PFAS is present in groundwater at Area 1. Directly downgradient of storm drain outfall.	• Evaluate need for vertical profile location further upgradient, northwest of 57VP-1-1, based on a review of the magnitude and depth of the borings advanced at this area. • Evaluate need for vertical profile location further cross gradient, north and south of 57VP-1-1, based on a review of the magnitude and depth of the borings advanced at this area.
57VP-1-2	Determine if PFAS is present in groundwater at Area 1. Directly downgradient of storm drain outfall.	• Evaluate need for vertical profile location further downgradient, southeast of 57VP-1-2, based on a review of the magnitude and depth of the borings advanced at this area. • Evaluate need for vertical profile location further cross gradient, north and south of 57VP-1-2, based on a review of the magnitude and depth of the borings advanced at this area.
Area of Concern 57, Area 2		
57VP-2-1	Determine if PFAS is present in groundwater upgradient of Area 2.	• Evaluate need for a vertical profile location further upgradient, northwest of 57VP-2-1, based on a review of the magnitude and depth of detections at this profile. • Evaluate need for a vertical profile location further cross gradient, northeast and west of 57VP-2-1, based on a review of the magnitude and depth of detections at this profile.
57VP-2-2	Characterize vertical extent of PFAS in groundwater within area of known PFAS contamination in groundwater.	• Evaluate data from surrounding locations.
57VP-2-3	Determine if PFAS is present at Area 2 groundwater cross gradient to upgradient portion of Area 2.	• Evaluate need for a vertical profile location further upgradient and cross gradient, to the northwest of 57VP-2-3 based on a review of the magnitude and depth of detections at this profile.
57VP-2-4	Determine if PFAS is present at Area 2 groundwater cross gradient to upgradient portion of Area 2.	• Evaluate need for a vertical profile location further upgradient and cross gradient, to the northeast of 57VP-2-4 based on a review of the magnitude and depth of detections at this profile.
57VP-2-5	Determine if PFAS is present at Area 2 groundwater cross gradient to downgradient portion of Area 2, adjacent to Cold Spring Brook.	• Evaluate need for a vertical profile location cross gradient further to the west based on a review of magnitude and depth of detections at this profile. • Evaluate potential for underflow of Cold Spring Brook, by reviewing elevation of observed PFAS in groundwater at this location and considering vertical hydraulic gradients measured at nearby nested piezometers or monitoring wells at this AOC.
57VP-2-6	Characterize vertical extent of PFAS in groundwater within area of known PFAS contamination in groundwater, adjacent to Cold Spring Brook.	• Evaluate potential for underflow of Cold Spring brook, by reviewing elevation of observed PFAS and measuring vertical hydraulic gradients with installation of nested piezometers or monitoring wells at this location.
57VP-2-7	Determine if PFAS is present at Area 2 groundwater cross gradient to downgradient portion of Area 2, adjacent to Cold Spring Brook.	• Evaluate need for a vertical profile location cross gradient further to the northeast based on a review of magnitude and depth of detections at this profile. • Evaluate potential for underflow of Cold Spring Brook, by reviewing elevation of observed PFAS in groundwater at this location and considering vertical hydraulic gradients measured at nearby nested piezometers or monitoring wells at this AOC.

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Proposed Location	Rationale	Path Forward If PFAS is Detected in Groundwater[1]
Area of Concern 57, Area 3		
57VP-3-1	Determine if PFAS is present in groundwater upgradient and cross gradient of known groundwater contamination at Area 3.	• Evaluate need for a vertical profile location further upgradient cross gradient, to the northwest of 57-3-1. Distance to be dependent on magnitude and depth of detections.
57VP-3-2	Determine if PFAS is present in groundwater upgradient of known groundwater contamination at Area 3.	• Evaluate need for a vertical profile location further upgradient, to the north of 57-3-2. Distance to be dependent on magnitude and depth of detections.
57VP-3-3	Determine if PFAS is present in groundwater upgradient and cross gradient of known groundwater contamination at Area 3.	• Evaluate need for a vertical profile location further upgradient and cross gradient, to the northeast of 57-3-3. Distance to be dependent on magnitude and depth of detections.
57VP-3-4	Characterize vertical extent of PFAS in groundwater at an area of known PFAS contamination in groundwater.	• Evaluate data from surrounding locations.
57VP-3-5	Determine if PFAS is present at Area 3 groundwater cross gradient to downgradient portion of Area 3, adjacent to Cold Spring Brook.	• Evaluate need for a vertical profile location cross gradient, southwest of 57VP-3-5, based on a review of magnitude and depth of detections at this profile. • Evaluate potential for underflow of Cold Spring Brook, by reviewing elevation of observed PFAS in groundwater at this location and considering vertical hydraulic gradients measured at nearby nested piezometers or monitoring wells at this AOC.
57VP-3-6	Characterize vertical extent of PFAS in groundwater at an area of known PFAS contamination in groundwater.	• Evaluate potential for underflow of Cold Spring brook, by reviewing elevation of observed PFAS and measuring vertical hydraulic gradients with installation of nested piezometers or monitoring wells at this location.
57VP-3-7	Determine if PFAS is present at Area 3 groundwater cross gradient to downgradient portion of Area 3, adjacent to Cold Spring Brook.	• Evaluate need for a vertical profile location cross gradient further to the northeast based on a review of magnitude and depth of detections at this profile. • Evaluate potential for underflow of Cold Spring Brook, by reviewing elevation of observed PFAS in groundwater at this location and considering vertical hydraulic gradients measured at nearby nested piezometers or monitoring wells at this AOC.

Notes:
AOC = Area of Concern
PFAS = per- and poly-fluoroalkyl substances

Notes:
1. Evaluation of need for additional vertical profiling locations will be based on a review of PFAS data from this, nearby vertical profiles, and existing monitoring wells to determine if data gaps regarding the extent of PFAS contamination in groundwater exist.

Table 2
Existing Monitoring Well Construction Information
Area 1 Field Sampling Plan
Devens PFAS RI Workplan

Monitoring Well	Screen Interval	Well Screen Intervals	Top of Casing Elevation	Ground Surface Elevation
	(ft NGVD)	(ft BTOC)	(ft NGVD)	(ft NGVD)
Grove Pond Well Field				
92-5	--	--	--	--
CSMS-11-01	214.3 - 224.3	30 - 40	224.29	251.27
CSMS-11-02	212.7 - 222.7	30 - 40	252.68	249.49
MNG-3	191.6 - 201.6	--	254.56	252.16
MNG-2*	--	--	238.81	236.11
MNG-5*	--	--	238.06	235.73
MNG-6*	--	--	254.87	250.8
MNG-7*	--	--	254.65	250.58
AOC-57 Area 2				
57M-03-01X	215.50 – 225.50	12.40 - 22.40	237.90	235.50
57M-03-02X	213.30 – 223.30	3.80 - 13.80	227.10	225.30
57M-03-03X	210.34 – 220.34	3.30 - 13.30	223.64	222.34
57M-03-04X	210.22 – 220.22	3.80 - 13.80	224.02	222.22
57M-03-05X	214.87 – 224.87	3.90 - 13.90	224.33	222.43
57M-03-06X	212.34 – 222.34	3.50 - 13.50	224.56	223.06
57M-95-05X	215.48 - 225.48	12.44 - 22.44	237.31	234.87
57M-95-06X	214.87 – 224.87	14.22 - 24.22	236.56	234.42
57M-95-07X	212.34 – 222.34	4.21 - 14.21	224.57	223.36
57WP-05-01	210.36 – 220.36	--	--	--
57WP-06-02	215.48 - 225.48	20.00 - 25.00	222.91	--
AOC-57 Area 3				
57M-95-03X	215.48 - 225.48	9.49 - 19.49	234.97	232.48
57M-96-10X	214.09 - 224.09	5.46 - 15.46	229.55	227.09
57M-96-11X	210.18 - 220.18	4.20 - 14.20	224.38	222.18
57M-96-12X	212.82 - 222.82	5.05 - 15.05	227.87	224.82
57M-96-13X	213.06 - 223.06	4.67 - 14.67	227.73	225.06
57P-98-03X	--	--	222.58	--
57P-98-04X	--	--	223.72	--
57WP-06-03	202.69 - 207.69	15.00 - 20.00	222.69	--

Key:
AOC = Area of Concern
bgs = below ground surface
BTOC = below top to casing
ft = feet
NGVD = National Geodetic Vertical Datum
PFAS = per- and polyfluoroalkyl substances
* = the well is damaged, well repair will be evaluated, and potentially conducted. If well repairs are conducted and are successful, the well will be sampled.
-- = Information is not available